

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE  
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Appellants: Hans Lobl et al.

Group Art Unit: 2811

Application No.: 10/527,115

Examiner: Nadav, Ori

Filed: March 8, 2005

Confirmation No.: 9528

For: BULK ACOUSTIC WAVE RESONATOR WITH MEANS  
FOR SUPPRESSION OF PASS-BAND RIPPLE IN BULK  
ACOUSTIC WAVE FILTERS

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APPEAL BRIEF UNDER 37 C.F.R. § 41.37(a)

This is an appeal to the Board of Patent Appeals and Interferences from the decision of the Examiner dated November 25, 2009, which finally rejected claims 7-10 and 15-24 in the above-identified application. The Office date of receipt of Appellants' Notice of Appeal was February 25, 2010. This Appeal Brief is hereby submitted pursuant to 37 C.F.R. § 41.37(a).

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### **I. REAL PARTY IN INTEREST**

The real party in interest is the assignee of the full interest in the invention: NXP B.V., of Eindhoven, Netherlands.

### **II. RELATED APPEALS AND INTERFERENCES**

To the best of Appellants' knowledge, there are no appeals or interferences related to the present appeal that will directly affect, be directly affected by, or have a bearing on the Board's decision in the instant appeal.

### **III. STATUS OF CLAIMS**

Claims 1-5 are canceled.

Claims 6, 11-14, and 25 are withdrawn. Specifically, claims 6 and 13 were withdrawn by Appellants in the response mailed June 6, 2008, and claims 11, 12, 14, and 25 were withdrawn Appellants in the response mailed January 25, 2010.

No claims are objected to.

Claims 7-10 and 15-24 stand rejected as follows:

Claims 7, 8, and 16 stand rejected under 35 U.S.C. § 102(e) as being anticipated by Nishihara et al. (U.S. Pat. No. 6,734,763, hereinafter Nishihara).

Claims 7, 8, and 16-24 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Nishihara.

Claims 9, 10, and 15 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Nishihara in view of Kobrin et al. (U.S. Pat. No. 5,936,150, hereinafter Kobrin).

Claims 7-10 and 15-24 are the subject of this appeal. A copy of the claims is set forth in the Claims Appendix.

### **IV. STATUS OF AMENDMENTS**

A proposed amendment was submitted subsequent to the Final Office Action mailed November 25, 2009. The proposed amendment was submitted to withdraw claims 11, 12, 14, and 25. These amendments were entered by the Examiner. Consequently, the

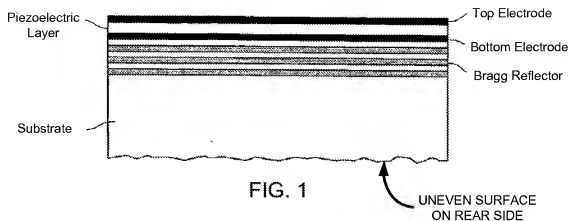
currently asserted grounds of rejection relating to claims 11, 12, 14, and 25 are moot and are not addressed further below.

## **V. SUMMARY OF CLAIMED SUBJECT MATTER**

This section of this Appeal Brief is set forth to comply with the requirements of 37 C.F.R. § 41.37(c)(1)(v) and is not intended to limit the scope of the claims in any way. Examples of implementations of the limitations of independent claims 7 and 20 are described below.

The language of claim 7 relates to a bulk acoustic wave (BAW) resonator. Detailed Description, page 4, lines 14-25. In particular, claim 7 recites a top electrode, a piezoelectric layer, a bottom electrode, and a substrate. The piezoelectric layer is disposed adjacent to the top electrode. Detailed Description, page 4, lines 14-25. The bottom electrode is disposed adjacent to the piezoelectric layer, and opposite the top electrode relative to the piezoelectric layer. Detailed Description, page 4, lines 14-25. The substrate is disposed opposite the piezoelectric layer relative to the bottom electrode and has an uneven surface to suppress a spurious mode. Detailed Description, page 4, lines 21-23. The uneven surface of the substrate is on a rear side of the substrate facing away from the bottom electrode. Detailed Description, page 4, lines 14-25.

Fig. 1 of the present application provides one example of an uneven surface on a rear side of a substrate. (For reference, Fig. 1 was amended on February 6, 2008, to correspond with the description provided in the specification.) Fig. 1 shows the uneven surface on the rear side of the substrate. In other words, the uneven surface is on the side that is facing away from the bottom electrode (i.e., the side that is furthest from the bottom electrode in Fig. 1), rather than the top side (i.e., the side that is closest to the bottom electrode in Fig. 1). This embodiment depicted in Fig. 1 and reproduced herein is only one example of the indicated language recited in claim 1. Other embodiment may have other configurations, and the scope of the claims is established by the actual language recited in the claims, not by the examples provided herein. Nevertheless, this example clearly illustrates an embodiment of the relationship between the bottom electrode and the side of the substrate that has the uneven surface.



The language of claim 20 relates to a bulk acoustic wave (BAW) filter. Page 1, lines 6-12. In particular, claim 20 recites a first BAW resonator and a second BAW resonator. Page 3, lines 6-8. The first BAW resonator suppresses a pass-band ripple of a spurious mode. Page 1, line 23, to page 2, line 11. The second BAW resonator is connected to the first BAW resonator and suppresses the pass-band ripple of a spurious mode. Page 1, line 23, to page 2, line 11. Page 3, lines 4-6. Each of the first and second BAW resonators includes a substrate with an uneven surface to suppress a spurious mode. Detailed Description, page 4, lines 21-23. The uneven surface is on a rear side of the substrate facing away from the first and second BAW resonators. Detailed Description, page 4, lines 14-25.

#### **VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL**

- A. Whether claims 7, 8, and 16 are patentable over Nishihara under 35 U.S.C. § 102(e).
- B. Whether claims 7, 8, and 16-24 are patentable over Nishihara under 35 U.S.C. § 103(a).
- C. Whether claims 9, 10, and 15 are patentable over Nishihara and Kobrin under 35 U.S.C. § 103(a).

## VII. ARGUMENT

For the purposes of this appeal, claims 7, 8, and 16 are argued together as a group for purposes of the question of patentability over Nishihara under 35 U.S.C. § 102(e). Claims 7, 8, and 16-24 are argued together as a separate group for purposes of the question of patentability over Nishihara under 35 U.S.C. § 103(a). Claims 9, 10, and 15 are argued as a separate group for purposes of the question of patentability over Nishihara in view of Kobrin under 35 U.S.C. § 103(a).

A. Claims 7, 8, and 16 are patentable over Nishihara because Nishihara does not disclose all the limitations of the claims.

Appellants respectfully submit that claims 7, 8, and 16 are patentable over Nishihara because Nishihara does not disclose all of the limitations of the claims. Specifically, claim 7 recites:

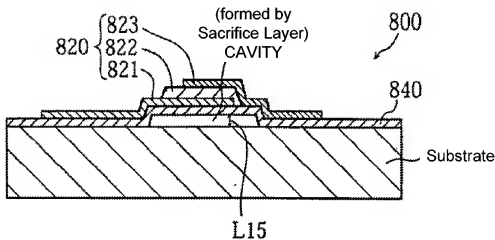
A bulk acoustic wave (BAW) resonator comprising:  
a top electrode;  
a piezoelectric layer disposed adjacent to the top electrode;  
a bottom electrode disposed adjacent to the piezoelectric layer,  
wherein the bottom electrode is disposed opposite the top electrode  
relative to the piezoelectric layer; and  
a substrate disposed opposite the piezoelectric layer relative to the  
bottom electrode, wherein the substrate comprises an uneven surface to  
suppress a spurious mode, wherein the uneven surface is on a rear side of  
the substrate facing away from the bottom electrode.

(Emphasis added.)

Appellants respectfully submit that claim 7 is patentable over Nishihara under 35 U.S.C. § 102(e) because Nishihara does not disclose an uneven surface on a rear side of the substrate facing away from the bottom electrode. Although Nishihara indirectly mentions a surface roughness of a silicon substrate relative to the surface roughness of the sacrifice layer described in reference to Fig. 21, Nishihara does not state which surface of the substrate might have the surface roughness. The failure to mention the surface roughness on a particular side of the substrate amounts to a failure to disclose the surface roughness on a rear side of the substrate facing away from the bottom electrode.

Moreover, in view of the context of the description of Nishihara, it appears that Nishihara implicitly refers to the top surface of the substrate on which the sacrifice layer is disposed to form the cavity. Fig. 21 of Nishihara is reproduced below to show the relationship of the cavity (formed by the sacrifice layer) and the substrate.

FIG.21  
PRIOR ART



Specifically, Nishihara compares the surface roughness of the sacrifice layer to that of the substrate on which the sacrifice layer is disposed. Nishihara specifically describes forming a polished and clean surface in each of the resonator cavities. Nishihara, col. 3, lines 12-27. Nishihara also explains that the orientation of the lower electrode would deteriorate which would make obtaining good resonance characteristics difficult. Moreover, Nishihara describes the formation of smooth features on the resonator results in a production efficiency that is substantially higher. Nishihara, col. 6, lines 6-16.

Therefore, the only correlation between the sacrifice layer and the substrate appears to be on the top surface (i.e., the surface closest to the cavity and the electrodes in Fig. 21). In contrast, there appears to be no correlation between the surface roughness of

the sacrifice layer and the bottom surface of the substrate (i.e., the surface furthest from the cavity and the electrodes in Fig. 21). Hence, the description in Nishihara at best describes a surface roughness of the top surface, but is insufficient to disclose an uneven surface on the rear side of the substrate.

Furthermore, since Nishihara does not disclose a surface roughness on a rear side of the substrate, Nishihara also fails to disclose a surface roughness on a rear side of the substrate facing away from the bottom electrode to suppress a spurious mode.

Therefore, Nishihara does not disclose all of the limitations of claim 7 because Nishihara does not disclose an uneven surface on a rear side of the substrate. Additionally, Nishihara fails to disclose an uneven surface to suppress a spurious mode. Accordingly, Appellants respectfully submit that claim 7 is patentable over Nishihara under 35 U.S.C. § 102(e) because Nishihara does not disclose all the limitations of the claims.

Given that each of claims 8 and 16 depends from and incorporates all of the limitations of independent claim 7, Appellants respectfully submits that claims 8 and 16 are patentable over Nishihara for depending from an allowable base claim. Additionally, each of claims 8 and 16 may be allowable for further reasons.

B. Claims 7, 8, and 16-24 are patentable over Nishihara because it would not have been obvious to modify Nishihara to include an uneven surface.

Appellants respectfully submit that claims 7, 8, and 16-24 are patentable over Nishihara because it would not have been obvious to modify Nishihara to include the missing limitations of the claims. As a proposed motivation to support the conclusion of obviousness, the Examiner asserts:

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to use a substrate with an uneven surface, wherein the uneven surface is on a rear side of the substrate facing away from the bottom electrode in Nishihara et al.'s device in order to form the device as understood by Nishihara et al.'s teachings, and in order to improve the device characteristics by improving the adhesion between the substrate and the device structure (by having the uneven surface on a rear side of the substrate), respectively.

Office Action, 11/25/2009, pages 5-6 (emphasis added).



However, Appellants assert that the reasons cited by the Examiner to support the purported conclusion of obviousness are insufficient. Specifically, evidence within the disclosure of Nishihara is presented which directly contradicts the Examiner's suggested modification.

First, the suggestion that it would have been obvious to modify Nishihara to include an uneven surface "in order to form the device as understood by Nishihara et al." is unclear and further gives no rational underpinning to support the asserted conclusion of obviousness. Appellants submit that if the device of Nishihara were modified, the reason to modify the device cannot come from the description of the Nishihara itself, because the device described in Nishihara is not modified in the manner suggested by the Examiner. Hence, the described process to form the unmodified device cannot logically be the basis for suggesting a modification to the device. Moreover, the device described in Nishihara would not need to be modified in order to form the device as it is already described. Therefore, the assertion that it purportedly would have been obvious to modify the substrate with an uneven surface on a rear side of the substrate to form the device of Nishihara, which is not described with such a surface, cannot be considered a rational underpinning because the argument is not logical.

Second, the Examiner does not provide reasoning to show how an uneven surface on the side of the substrate that faces away from the bottom electrode would improve adhesion between the substrate and the device structure. Nishihara does not teach adhesion between the substrate and the device structure. However, Nishihara teaches that direct bonding or anodic bonding may be used to secure the cover substrate to the silicon substrate. Nishihara, col. 12, lines 45-50. In the modification suggested by the Examiner, the direct bonding or anodic bonding would suffer greatly with a rough surface area because the rough surface area would reduce the amount of contact area of the substrate that would otherwise facilitate anodic bonding. Therefore, the assumption made by the Examiner that it would be obvious to use a substrate with an uneven surface in order to improve the device characteristics by improving adhesion is technically incorrect.

Therefore, it would not have been obvious to modify the teachings of Nishihara based on the reasons asserted by the Examiner because Nishihara does not provide any motivation to modify its own disclosure. Also, modifying the device of Nishihara would not achieve the stated objective of improving adhesion, but rather would reduce the indicated adhesion. Accordingly, Appellants respectfully submit that claim 7 is patentable over Nishihara under 35 U.S.C. § 103(a) because the Examiner does not establish a *prima facie* case of obviousness.

Appellants respectfully assert independent claim 20 is also patentable over Nishihara at least for similar reasons to those stated above in regard to the rejection of independent claim 1. In particular, the rejection of claim 20 merely relies on the same reasoning that the Examiner provided for the rejection of claim 1. Here, although the language of claim 20 differs from the language of claim 1, and scope of each claim should be interpreted independently of other claims, Appellants respectfully assert that the remarks provided above in regard to the rejection of claim 1 also apply to the rejection of claim 20. Accordingly, Appellants respectfully assert independent claim 20 is patentable over Nishihara because it would not have been obvious to modify Nishihara.

Given that claims 8, 16-19, and 21-24 depends from and incorporates all of the limitations of the corresponding independent claims 7 and 20, Appellants respectfully submits that claims 8, 16-19, and 21-24 are patentable over Nishihara for depending from an allowable base claim. Additionally, each of claims 8, 16-19, and 21-24 may be allowable for further reasons.

C. Claims 9, 10, and 11 are patentable over Nishihara and Kobrin because the combination of cited references does not teach all of the limitations of the claims.

Appellant respectfully submits that claims 9, 10, and 11 are patentable over Nishihara and Kobrin because each of claims 9, 10, and 11 depends from and incorporates all of the limitations of independent claim 7. Additionally, each of claims 9, 10, and 11 may be allowable for further reasons.

### VIII. CONCLUSION

For the reasons stated above, claims 7-10 and 15-24 are patentable over the cited references. Thus, the rejections of claims 7-10 and 15-24 should be withdrawn.

Appellant respectfully requests that the Board reverse the rejections of claims 7-10 and 15-24 under 35 U.S.C. §§ 102(e) and 103(a).

At any time during the pendency of this application, please charge any fees required or credit any over payment to Deposit Account **50-4019** pursuant to 37 C.F.R. 1.25. Additionally, please charge any fees to Deposit Account **50-4019** under 37 C.F.R. 1.16, 1.17, 1.19, 1.20 and 1.21.

Respectfully submitted,

/Jeffrey T. Holman/

Date: April 26, 2010

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## **IX. CLAIMS APPENDIX**

### **Listing of Claims:**

- 1-5. (canceled)
6. (withdrawn) Method for manufacturing a bulk acoustic wave resonator comprising the steps of
  - providing a holder in the form of a silicon chip or dice,
  - disposing a top electrode on the silicon dice,
  - disposing a piezoelectric layer,
  - disposing a bottom electrode,
  - disposing a Bragg reflector,
  - disposing a front side absorbing layer,
  - disposing a substrate, and
  - removing the holder.
7. A bulk acoustic wave (BAW) resonator comprising:
  - a top electrode;
  - a piezoelectric layer disposed adjacent to the top electrode;
  - a bottom electrode disposed adjacent to the piezoelectric layer, wherein the bottom electrode is disposed opposite the top electrode relative to the piezoelectric layer;and
  - a substrate disposed opposite the piezoelectric layer relative to the bottom electrode, wherein the substrate comprises an uneven surface to suppress a spurious mode, wherein the uneven surface is on a rear side of the substrate facing away from the bottom electrode.
8. The BAW resonator of claim 7, wherein the uneven surface of the substrate comprises a roughened surface to scatter the spurious mode.

9. The BAW resonator of claim 8, wherein the roughened surface of the substrate comprises an etched surface of glass.
10. The BAW resonator of claim 8, wherein the roughened surface of the substrate comprises a blasted layer of glass.
11. (withdrawn) The BAW resonator of claim 7, further comprising an absorbing layer disposed on the substrate to absorb the spurious mode.
12. (withdrawn) The BAW resonator of claim 11, wherein the absorbing layer is disposed on a front side of the substrate, between the substrate and the bottom electrode.
13. (withdrawn) The BAW resonator of claim 11, wherein the absorbing layer is disposed on the rear side of the substrate, opposite the bottom electrode relative to the substrate.
14. (withdrawn) The BAW resonator of claim 11, wherein the absorbing layer comprises at least one acoustic absorbing material of a plurality of acoustic absorbing materials, wherein the plurality of acoustic absorbing materials comprises epoxy glue, an elasticoviscous material, rubber, silicon rubber, a plastic material, a porous media, and a porous thin film.
15. The BAW resonator of claim 7, further comprising a Bragg reflector disposed between the substrate and the bottom electrode.
16. The BAW resonator of claim 7, wherein:
  - the top electrode comprises a first metal material;
  - the piezoelectric layer comprises at least one of a plurality of piezoelectric material; and
  - the bottom electrode comprises a second metal material.
17. The BAW resonator of claim 16, wherein the first metal material of the top electrode comprises aluminum (Al).

18. The BAW resonator of claim 16, wherein the plurality of piezoelectric materials comprises aluminum nitride (AlN), zinc oxide (ZnO), and lead zirconate titanate (PZT).
19. The BAW resonator of claim 16, wherein the second metal material of the bottom of electrode comprises molybdenum (Mo), platinum (Pt), or tungsten (W).
20. A bulk acoustic wave (BAW) filter comprising:  
a first BAW resonator to suppress a pass-band ripple of a spurious mode; and  
a second BAW resonator connected to the first BAW resonator, the second BAW resonator to suppress the pass-band ripple of a spurious mode;  
wherein each of the first and second BAW resonators comprises a substrate with an uneven surface to suppress a spurious mode, wherein the uneven surface is on a rear side of the substrate facing away from the first and second BAW resonators.
21. The BAW filter of claim 20, wherein the first and second BAW resonators are connected in a ladder configuration.
22. The BAW filter of claim 20, wherein the first and second BAW resonators are connected in a lattice configuration.
23. The BAW filter of claim 20, wherein each of the first and second BAW resonators comprises:  
a top electrode;  
a piezoelectric layer disposed adjacent to the top electrode; and  
a bottom electrode disposed adjacent to the piezoelectric layer, wherein the bottom electrode is disposed opposite the top electrode relative to the piezoelectric layer;  
wherein the substrate is disposed opposite the piezoelectric layer relative to the bottom electrode.

24. The BAW filter of claim 20, wherein the uneven surface of the substrate comprises a roughened surface to scatter the spurious mode.
25. (withdrawn) The BAW filter of claim 20, further comprising an absorbing layer disposed on the uneven surface of the substrate to absorb the spurious mode.

## **X. EVIDENCE APPENDIX**

There is no evidence submitted with this Appeal Brief.



## **XI. RELATED PROCEEDINGS APPENDIX**

To the best of Appellants' knowledge, there are no appeals or interferences related to the present appeal that will directly affect, be directly affected by, or have a bearing on the Board's decision in the instant appeal.